5917

Department of Energy

Ohio Field Office
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MAY 3 2005

Mr. Gene Jablonowski, Remedial Project Manager
United States Environmental Protection Agency
Region V, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

· DOE-0235-05

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 E. 5th Street
Dayton, OH 45402-2911

Dear Mr. Jablonowski and Mr. Schneider:

REVISED TRANSPORTATION AND DISPOSAL PLAN FOR THE SILOS 1 AND 2 PROJECT

Reference: DOE Letter, DOE-0393-04, William J. Taylor to Gene Jablonowski and Tom Schneider, "Transportation and Disposal Plan for the Silos 1 and 2 Project," dated April 21, 2004

Enclosed for your review and approval is a revised Transportation and Disposal Plan for the Silos 1 and 2 Project.

The original draft plan, submitted to USEPA and OEPA in Reference 1, documented the procedures and methods for truck transportation of treated Silos 1 and 2 material to the Department of Energy (DOE) Nevada Test Site (NTS) for disposal. The enclosed revised plan reflects direct truck transportation to Waste Control Specialists, LLC (WCS) in Andrews Texas for temporary storage in accordance with the Explanation of Significant Differences (ESD) for Operable Unit 4 (OU4).

As required by the OU4 ESD, no more than two years from the date storage of Silos 1 and 2 material at WCS is initiated, the material will be either 1) permanently disposed at WCS facility in accordance with the OU4 remedy, an approved 11e.(2) disposal license, and all other applicable regulatory requirements, or 2) transported to the NTS and/or a PCDF for permanent disposal. The details concerning permanent disposal at WCS or another government owned or

commercial facility, including any subsequent transportation, will be documented and submitted for review and approval in a Transportation and Disposal Plan revision no later than 18 months from the initiation of temporary storage at WCS.

Fluor Fernald, Inc. awarded a contract for temporary storage of the Silos 1 and 2 materials to WCS on April 28, 2005. Review and closure of actions from the Standard Startup Review (SSR) and Readiness Assessment is currently in process and is expected to be completed during May. Operation of the Silos 1 and 2 Remediation Facility, and shipment of Silos 1 and 2 material to WCS, will be initiated immediately thereafter.

If you have any questions, please contact John Sattler at (513) 648-3145.

Sincerely,

William J. Taylor
Director

FCP:Sattler

Enclosure: As Stated

cc w/enclosure:
J. Reising, OH/FCP
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ECDC, Fluor Fernald, Inc./MS52-7

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FCP-40750-PL-0018
Revision 2
May 2005

SILOS 1 and 2 PROJECT TRANSPORTATION AND DISPOSAL PLAN

40750-PL-0018, REV. 2

May 2005

APPROVED BY:

John North, Project Manager, Silos 1 and 2 Project — 02 May 2005 Date

Robert F. Schulten, Shipping and Receiving — 5-2-05 Date

FERNALD CLOSURE PROJECT
FERNALD, OHIO

U.S. DEPARTMENT OF ENERGY

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FIGURES

RECORD OF ISSUE/REVISIONS

EFFECTIVE DATE	REV. NO.	DESCRIPTION
August 5, 2004	0	New plan issued to describe transportation and disposal operations for Silos 1 and 2 materials.
August 26, 2004	1	Revised plan issued to incorporate comments from DOE review for submittal to USEPA/OEPA
May 3, 2005	2	Revised plan issued to reflect transportation to WCS for temporary offsite storage

ACRONYMS

ACEM	Activity Concentration for Exempt Material
AEA	Atomic Energy Act
AEDO	Assistant Emergency Duty Officer
ALEC	Activity Limit for Exempt Consignment
ASME	American Society of Mechanical Engineers
Bq	Becquerels
Bq/g	Becquerels per gram
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRF	Cancer Risk Factor
DOE	Department of Energy
DOT	Department of Transportation
EDO	Emergency Duty Officer
EMS	Emergency Management System
EOC	Emergency Operations Center
ERP	Emergency Response Plan
FCP	Fernald Closure Project
HMR	Hazardous Material Regulations
HRCQ	Highway Route Controlled Quantity
ILCR	Incremental Lifetime Cancer Risk
IP-2	Industrial Packaging-Type 2
ISMS	Integrated Safety Management System
LCF	Latent Cancer Fatalities
LSA	Low Specific Activity
MCEP	Motor Carrier Evaluation Program
MEF	Material Evaluation Form
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NHASP	Nuclear Health and Safety Plan
NTS	Nevada Test Site
NTSWAC	Nevada Test Site Waste Acceptance Criteria
OU	Operable Unit
PCDF	Permitted Commercial Disposal Facility
Ra-226	Radium 226
Ra-228	Radium 228
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Control Technician
RD/RA	Remedial Design/Remedial Action
RDP	Remedial Design Package
RI	Remedial Investigation
ROD	Record of Decision
RPP	Radiological Protection Program
RSPA	Research and Special Programs Administration
RWP	Radiological Work Permit

SPR	Safety Performance Requirement
SR	State Route
SRC	Safety Review Committee
TBq	Terabecquerels
TBq/g	Terabecquerels per gram
TCLP	Toxicity Characteristic Leaching Procedure
TEP	Transportation Emergency Plan
TEPP	Transportation Emergency Preparedness Program
Th-230	Thorium 230
TRAGIS	Transportation Routing Analysis Geographic Information System
TSA	Trailer Staging Area
WAC	Waste Acceptance Criteria
WC	Waste Characterization
WCS	Waste Control Specialists LLC

1.0 INTRODUCTION

1.1 PURPOSE AND SCOPE

This plan describes the staging and transportation of Operable Unit (OU) 4 Silos 1 and 2 material from the Fernald Closure Project (FCP) to the Waste Control Specialists (WCS) facility in Andrews Texas. This plan serves to: (1) describe the transportation logistics associated with Silos 1 and 2 material; and (2) generally describe operational aspects of transportation plans to demonstrate that Silos 1 and 2 material can be transported to the designated storage/disposal site safely, and in accordance with applicable regulations.

Submittal of this Transportation and Disposal Plan complies with the requirements of the Silos 1 and 2 Remediation Facility Remedial Design Package (40750-RP-0028, Rev. 0, April 2003) which requires an operational description of the transportation and offsite management of Silos 1 and 2 material, including on-site staging pending shipment, logistics, packaging configuration, and selected mode of transportation to the selected offsite facility.

1.2 BACKGROUND

Silos 1 and 2 material consists of approximately 8,890 cubic yards of residues from uranium extraction operations at the Mallinckrodt Chemical Works and the FCP in the 1950s. Samples collected from Silos 1 and 2 indicate the presence of significant activity and concentrations of the radionuclides within the uranium decay series, confirming prior process knowledge. The predominant radionuclide of concern identified within Silos 1 and 2 is Radium-226. Approximately 3,770 curies of Radium-226 are distributed within the Silos 1 and 2 materials. (Note: The 3,770 curies is a mean inventory value. The 95% upper confidence limit inventory value is approximately 4,740 curies. For most determinations, the upper confidence limit values are used for conservatism.)

Since the time that DOE assumed ownership of the material in 1984, the Silos 1 and 2 materials have been classified as by-product material under Section 11e.(2) of the Atomic Energy Act (AEA), of 1954, as amended. This classification arises from the origin of the material, as "residue from the extraction or concentration of uranium from ores processed primarily for their source material content." The basis for DOE's classification of the Silos 1 and 2 material as 11e.(2) by-product material was documented in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Environmental Policy Act (NEPA), and approved by the DOE and U.S. EPA in the original Final Record of Decision for Operable Unit 4 Remedial Action in December 1994. Due to its classification as 11e.(2) by-product material, the Silos 1 and 2 materials are specifically exempt, as defined, from regulation as solid or hazardous waste under the Resource Conservation and Recovery Act (RCRA), 40 CFR 261.4(a)(4).

The Record of Decision (ROD) Amendment for Operable Unit (OU) 4 Silos 1 and 2 Remedial Action (40700-RP-0008, approved July 13, 2000) requires treatment by chemical stabilization. The Final Explanation of Significant Differences (ESD) for Operable Unit 4 Silos 1 and 2 Remedial Action (40750-RP-0038, approved November 24, 2003) modified the Silos 1 and 2 remedy specified in the ROD amendment to allow disposal at a Permitted Commercial Disposal Facility (PCDF), in addition to the previously-approved option of disposal at the Nevada Test Site (NTS), and removed the RCRA Toxicity Characteristic Leaching Procedure (TCLP) analysis as a treatment criterion for the stabilization process. The Final ESD for Operable Unit 4, signed January 18, 2005, modified the OU4 remedy to allow the option for temporary offsite storage of treated Silos 1 and 2 materials prior to permanent offsite disposal. In adding the option for temporary offsite storage, the ESD specified the following constraints:

- Temporary offsite storage must be at an offsite government-owned facility in accordance with the appropriate DOE-orders and other applicable regulations or at a commercial facility appropriately permitted by the relevant regulatory agency.
- Storage will be limited to a period of two years. No more than two years from the date storage of material from a particular silo is initiated, the material from that silo must be either 1) permanently disposed at the storage facility in accordance with the OU4 remedy and all applicable regulatory requirements, or 2) transported to the NTS and/or a PCDF for permanent disposal.
- Under no circumstances will it be allowable for the silo material to be returned to the FCP after it has been accepted at an offsite facility for temporary storage and/or final disposal.
- Transportation from FCP to the storage facility, and any subsequent transportation to a disposal facility must meet the transportation risk criteria and all other criteria and applicable regulations specified by the current remedies.

The FCP cleanup contractor, Fluor Fernald Inc., is responsible for material retrieval, chemical stabilization, and packaging; selection of the storage and/or disposal facility(s) and mode of transportation; analysis of the Silos 1 and 2 materials for compliance with the applicable acceptance criteria; loading Silos 1 and 2 materials for shipment; and transporting the Silos 1 and 2 materials to the selected facility. Plans and requirements for completing this scope are described in the Silos 1 and 2 Project Remedial Design/Remedial Action (RD/RA) Package (40430-RDP-0001, Rev. 2, December 2003).

Following a competitive procurement process, Waste Control Specialists, LLC in Andrews, Texas was awarded a contract for temporary storage of Silos 1 and 2 material in accordance with the requirements of the OU4 ESD. On February 23, 2005, WCS received approval modification to the radioactive materials license (L04971) from the Texas Department of State Health Services (TDSHS) to allow temporary storage of the treated Silos 1 and 2 materials at their disposal facility in Andrews, Texas. In addition, WCS has submitted an application for a license for disposal of 11e.(2) byproduct material to the TDSHS.

Fluor Fernald awarded a contract with Visionary Solutions, LLC to provide transportation of Silos 1 and 2 material from the FCP to WCS.

This plan is specific to direct-truck transportation of Silos 1 and 2 material to WCS for temporary storage in accordance with the OU4 ESD and the WCS radioactive materials license. Details concerning permanent disposal at WCS or another government owned or commercial facility, including any subsequent transportation, will be documented and submitted for review and approval once the permanent disposal location is selected. In order to allow review and approval within the maximum storage period allowed by the ESD, the Transportation and Disposal Plan revision providing the details for final disposal of the Silos 1 and 2 material will be submitted for approval no later than 18 months from the initiation of temporary storage at WCS. Disposal at any other government or commercial site, or use of another mode of transportation, will require a revision of this Transportation and Disposal Plan to reflect the receiving facility's license and permits and/or the alternate transportation mode.

2.0 CHARACTERISTICS OF SHIPPED MATERIAL

Prior to being packaged, the Silos 1 and 2 materials will be stabilized with a formulation of flyash and Portland cement. The waste loading in the stabilized waste is expected to average from 17 to 30 weight-percent Silos 1 and 2 material; therefore, 70 to 83 weight-percent of the final stabilized waste form will be inert, non-waste material additives. The chemical stabilization process results in a significant volume increase in exchange for elimination of free liquid and reduced mobility (leachability) of lead.

Radionuclide concentrations per waste package are expected to be in the following range (pCi/g):

Radium	226	-	100,000
Thorium	230	-	15,000
Lead	210	-	100,000
Polonium	210	-	100,000
Actinium	227	-	2,000

The final physical form of the treated waste will be a concrete monolith inside a sealed steel-shipping container. Anticipated direct radiation dose rates on the outside of the shipping container are:

- 75 millirem/hour on contact (DOT standard specifies on contact dose rate shall not exceed 200 millirem/hour)
- 9 millirem/hour at 2 meters from the package (DOT standard specifies dose at 2 meters shall not exceed 10 millirem/hour)

In accordance with 49 Code of Federal Regulations (CFR) Part 173.403, the treated Silos 1 and 2 material is classified as LSA-II material. Specifically, Silos 1 and 2 materials are considered "other material in which the radioactive material is distributed throughout and

the estimated average specific activity does not exceed 10-4 A2/g for solids..." The results of the LSA-II determination on Silos 1 and 2 materials are presented in Appendix A.

3.0 PACKAGING

Based on the LSA evaluation discussed above, the packaging requirement for the Silos 1 and 2 materials is an Industrial Packaging – Type 2 (IP-2) container. The current Silos 1 and 2 packaging design consists of a 76-inch diameter, 80-inch high, ½-inch thick cylindrical carbon steel containers with external volume of 208 cubic feet. In accordance with DOT IP-2 requirements, the containers have successfully passed all required DOT tests (i.e., free drop test and stacking test). The containers will be filled with the stabilized Silos 1 & 2 materials, weighed, labeled, and surveyed before being placed onto the flatbed trailer for shipping. There will be two containers on each trailer. The filled container will have a maximum weight of 21,950 pounds. The treated waste form will be a low compressive strength cement monolith with no free liquid present. Up to 7,000 filled containers are to be generated over an 11-month period.

The packaging configuration is illustrated below.

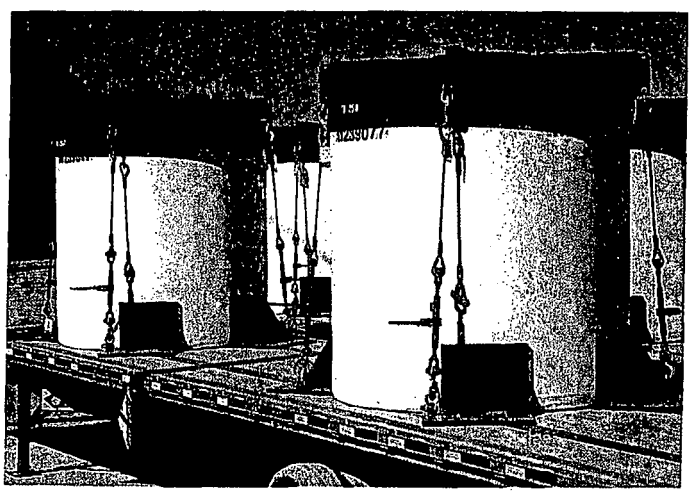


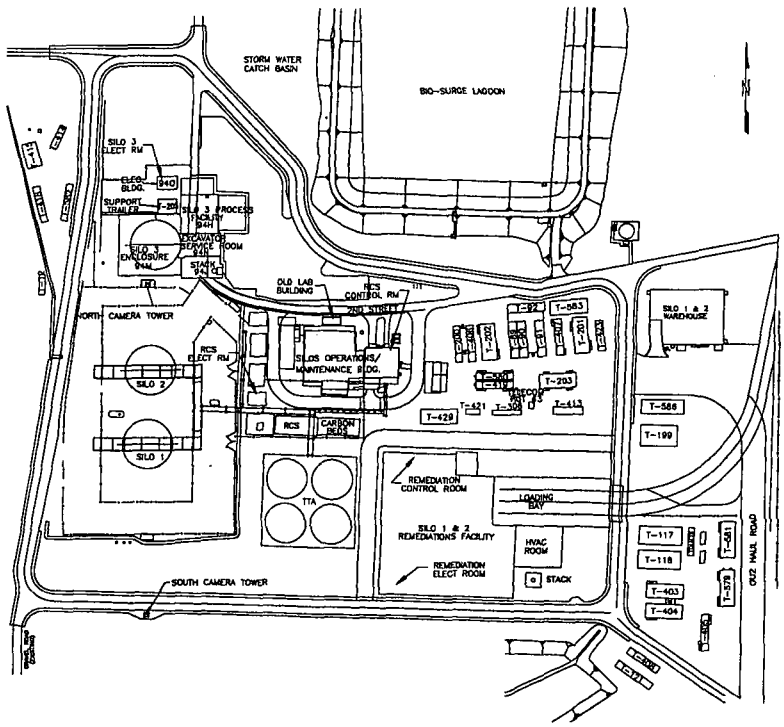
Figure 3-1: Silos 1 and 2 Packaging Configuration

"Radioactive, Class 7" placards will be placed on the front, back, and both sides of the tractor trailer in accordance with DOT placarding requirements.

4.0 ON-SITE STAGING AND INSPECTION

The following diagram illustrates the layout of the Silos 1 and 2 Area:

FIGURE 4-1



The loading will be done inside the Silos 1 and 2 Remediation Facility. The flatbed trailer will be pulled into the facility and an overhead bridge crane will be utilized to load the containers. Once the packages are approved for disposal, loading of the trailers will be performed as described in Section 3.3. Staging of filled containers that have been certified for shipment will be limited to the period of time necessary to facilitate ongoing, continuous shipments to WCS. Once a container has been filled, inspected, and certified for shipment, it will remain on-site for only the length of time required to facilitate logistics between FCP, transportation contractors, and WCS.

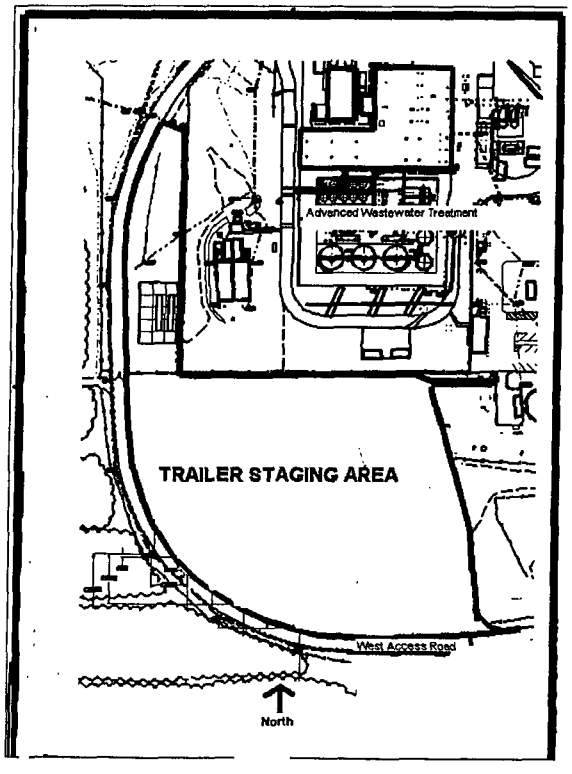
After the trailer is surveyed and released from the Silos area for shipment, the Shipping organization will prepare the remaining paperwork. Individual containers of Silos 1 and 2 materials will be tracked using the existing on-site waste tracking databases.

In order to ensure the safety and integrity of containers of Silos 1 and 2 material during onsite management and subsequent transportation, the inspection program includes the following inspection activities:

- Quality inspection of containers at the vendor site, before shipment to the FCP, to verify that the container has been manufactured in accordance with approved specifications.
- Inspection of empty containers upon receipt at the Silos 1 and 2 Remediation Facility for signs of damage during transport, verify the integrity of the gasket and lid, and verify the absence of liquid or foreign objects in the container.
- Quality Control oversight during Container filling, closure and weighing .
- Quality control review of process control data to verify WAC compliance
- Quality Control inspection after containers have been loaded to verify labeling, proper tie-down and container integrity.

After being unloaded at WCS, trailers will be surveyed and released for the return trip to the FCP. Visionary Solutions will maintain an ongoing, documented inspection program to ensure the operability and safety of the trailers. Upon arrival at the FCP, Inbound trailers will be moved to the Trailer Staging Area (TSA) for staging and any required maintenance and repair of unfit trailers. Following is a diagram of the TSA:

FIGURE 4-2



5.0 MATERIAL TRANSPORT

5.1 DEPARTMENT OF TRANSPORTATION REQUIREMENTS

The FCP shall comply with applicable federal, tribal, state, and local regulations. As described in Section 3, each package and shipment of hazardous materials for off-site shipment shall be prepared in compliance with 49 CFR 171-180, Hazardous Materials Regulations (HMR) and the applicable tribal, state, and local regulations.

5.2 MODE OF TRANSPORTATION

Direct truck, direct rail, and intermodal (combined truck/rail) were all considered as potential modes of transportation during design of the Silos 1 and 2 Remediation Facility, and subsequent transportation planning. Evaluation of transportation risk demonstrated that all three modes would provide safe transportation of the Silos 1 and 2 material. Truck transportation was used as the design basis to provide the flexibility for shipment to offsite locations not accessible by rail transport. Although the WCS facility is accessible by rail as well as by direct truck, it is not feasible at this stage of the project to retrofit the necessary on-site infrastructure to support rail shipments.

5.3 MOTOR CARRIER SELECTION

A contract has been awarded with Visionary Solutions, LLC to furnish motor carriers with satisfactory ratings under the Department of Energy (DOE) Motor Carrier Evaluation Program (MCEP).

The FCP provides a detailed briefing to every driver of radioactive material before the shipment departs the FCP. That briefing stresses emergency response actions to take in the unlikely event of an accident or severe weather, instructions for maintenance of exclusive use shipment controls, and the importance of remaining on the routes assigned by FCP. The FCP also requires motor carriers to utilize a satellite tracking system (e.g., Qualcomm) for each shipment and has made arrangements with the motor carriers to access that data as necessary to randomly verify the motor carrier is adhering to the assigned routes. Motor carrier drivers that fail to adhere to the assigned routes are prohibited from hauling future shipments of material for the FCP.

5.4 RISK AND SAFETY REQUIREMENTS

To demonstrate compliance with the transportation risk criteria imposed by the OU4 remedy, a transportation risk assessment was performed utilizing direct truck shipment to the NTS as a scenario representative of potential transportation modes and disposal locations. The assessment, which evaluated both potential risks associated with accident-free waste transportation (direct radiation) and the risks associated with an accident scenario, demonstrated that the transportation risk to members of the general public for both scenarios meets the criteria specified by the Silos 1 and 2 ROD Amendment. Evaluation of the assumptions and input parameters used for the evaluation documented in the Revised Feasibility Study for Silos 1 and 2 indicates that the evaluation sufficiently

bounds the risk associated with direct truck transportation to WCS to demonstrate compliance with the criteria specified by the Silos 1 and 2 remedy.

5.5 ROUTING

As defined by 49 CFR 172.403, Truck shipments of Silos 1 and 2 material are classified as Class 7 (Radioactive material), but do not contain a Highway Route Controlled Quantity (HRCQ). The planned route for truck shipments to WCS was selected In consideration of the requirements of 49 CFR 397 Subpart D, Routing of Class 7 (Radioactive) Materials, for minimization of radiological risk. Accident rates, transit time, population density and activities, and the time of day and week in which transportation will occur were considered as factors in evaluating potential transportation routes.

Potential transportation routes between the FCP and WCS were evaluated using DOE's Transportation Routing Analysis Geographic Information System (TRAGIS). TRAGIS results for the HRCQ preferred route, quickest route, shortest route, and commercial route are summarized below.

ROUTE	DISTANCE (miles)	TRAVEL TIME (hours)	POPULATION (within 800m)	PASS-THROUGH STATES
HRCQ Preferred	1389.4	24:07	549.032	OH, KY, TN, AR, TX
Quickest	1373.1	23:52	632,297	OH, KY, TN, AR, TX
Shortest	1307.7	25:53	456,907	OH, IN, IL, MO, OK, NM, TX
Commercial	1339.6	23:56	466,659	OH, IN, IL, MO, OK, NM, TX

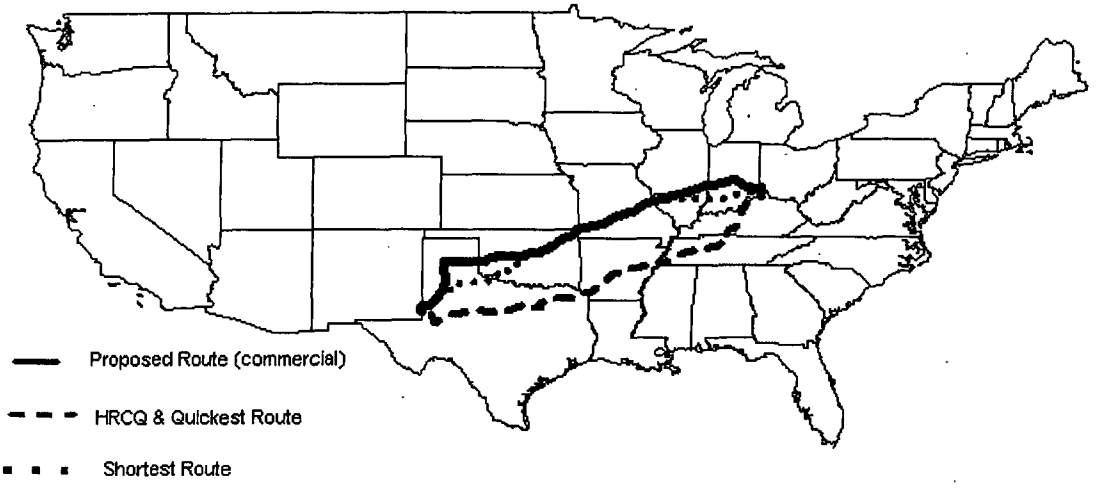
The planned primary route selected for shipments of Silos 1 and 2 material from the FCP to WCS falls along the TRAGIS 'Commercial Route'. As shown by the TRAGIS data summarized above, this route provides the best minimization of the three factors (travel time, distance, and population density. The route is described below, and illustrated on the map that follows.

FERNALD TO WCS, ANDREWS TEXAS
(1340 estimated miles)

From Fernald, OH Rte 128 to I275 to I74
I74 West to I465 loop (Indianapolis IN) to I70 West
I70 West to I255/I270 loop (St. Louis MO) to I44 West
I44 West (loops around Oklahoma City OK) to I40 West
I40 West to I27 South (Amarillo TX)
I27 to US62/82 (Lubbock TX)
US62/82 to Seminole TX
US62/180 to Hobbs NM
State Route 18 south to WCS

Interstate loops will be utilized around the following cities: Indianapolis, Indiana; St. Louis, Missouri / East St. Louis, Illinois, and Oklahoma City, Oklahoma. Bypass loops around other cities will be utilized where they exist.

Figure 5-1 TRAGIS Transportation Routes



Any necessary modification to the primary route will be communicated in advance to the impacted states.

6.0 EMERGENCY RESPONSE

6.1 INTRODUCTION

This section documents the emergency response procedures that are in place to respond to transportation accidents involving shipments of Silos 1 and 2 materials. The scope of this discussion focuses on off-site occurrences and references procedures for on-site occurrences.

DOE Order 151.1B, Comprehensive Emergency Management System, provides for a DOE Emergency Management System (EMS). This order requires sites and facilities to have emergency plans and procedures in place and to address transportation emergencies for onsite and offsite. The FCP has established plans and procedures. Also, pursuant to DOE Order 151.1, EM has authority to maintain the Transportation Emergency Preparedness Program, which assists Department of Energy (DOE) and other federal, state, tribal and local authorities to prepare for response to a transportation incident involving DOE shipments of radioactive material. DOE Order 151.1 also addresses DOE's responsibilities under the National Contingency Plan (NCP) and the Nuclear Rad Annex of the National Response Plan.

DOE Order 435.1, Radioactive Waste Management and associated manual DOE M 435.1-1, Chapter IV, Section L.2, Transportation, also state that the volume of waste and number of waste shipments shall be minimized to the extent practical. This requirement was considered in development of the Silos 1 and 2 waste form and associated transportation planning.

6.2 FCP EMERGENCY RESPONSE PREPAREDNESS PLANS

The FCP Transportation Emergency Plan (TEP), PL-3043, is part of the DOE-FCP Transportation Emergency Preparedness Program. The FCP TEP provides a centralized program approach to off-site transportation emergency response including products, samples, and waste shipments.

The FCP TEP describes the overall DOE/FCP process developed for the coordination of response efforts to off-site transportation incidents. This assistance planning is accomplished by adherence to applicable federal, state, and local transportation-related emergency response requirements, plus utilizing existing DOE programs designed to protect the well being of citizens and the environment from accidental release of transported materials.

Procedures for on-site emergencies are addressed in PL-3020, FCP Emergency Plan, which details the procedures to be followed at the FCP in the event of an accident or emergency, highlights FCP safety features, and governs the spill response actions. The FCP Emergency Plan is distributed to participating mutual aid organizations, such as local fire departments and hospitals, in the general vicinity of the FCP. Additionally, PL-2194, the FCP Spill Prevention Control and Countermeasure Plan will be implemented accordingly for incidents on, or in close proximity to, the FCP. Silos-specific emergency procedures are addressed in EM-0030, Silos Area Emergency Procedure.

6.3 EMERGENCY RESPONSE FOR THE FCP OFF-SITE SHIPMENTS

A Silos 1 and 2 material shipment will become an off-site shipment at the point when the entire shipment crosses the facility boundary. When the shipment is off-site, the motor carrier will be responsible for providing emergency response support to the local authorities in proximity of any incident. The carrier also will have contractors available for containment and cleanup as necessary. The FCP will provide technical assistance via the 24-hour emergency response telephone number. DOE will advise and provide support as requested by the local response authority (49 CFR 174.750). Local response personnel including police, firefighters, and emergency responders, typically are the first to arrive on the scene of an incident. They must be provided with the technical information needed by first responders to accurately identify the hazards involved in the incident. Information contained in the shipping papers includes source terms, health and safety concerns, and recommended protective actions. The information is consistent with the DOT, Research and Special Programs Administration (RSPA) publication, North American Emergency Response Guidebook, Guide 162.

Advance notification will be provided to state and tribal emergency response organizations prior to the beginning of the Silo 1 and 2 shipping campaign. The notification will include information such as the number of shipments, the type of material and packaging configuration, the projected dates for initiation and completion of shipments, and on-site contact information. Primarily for security reasons, current policy for waste shipments does not provide for notification of the date, time, and route of individual Silo 1 and 2 waste shipments.

The following is an overview of the emergency response responsibilities of the motor carriers, DOE, individual states, and the FCP to support local authorities at an accident scene.

1. Carriers
   - Trained in accordance with DOT Emergency Response Guidebook and the carrier's respective Emergency Response Plans
   - Stabilize situation
   - Provide notification of incident to carrier home office
   - Provide notification to Visionary Solutions, LLC

2. Carrier Emergency Response Organization
   - Make appropriate additional notification (local authorities, DOE, etc.)
   - Dispatch Emergency Response Personnel to the scene to support On-Scene Commander
   - Mobilize strategically positioned emergency response subcontractors, if necessary
   - Responsible for Recovery Actions

3. Local Authorities
   - Typically function as the On-Scene Commander

4. State Emergency Response Organizations
   - Each state possesses an Emergency Response Organization capable of responding to radiological emergencies

5. DOE Regional Radiological Assistance Teams
   - Eight Radiological Assistance Team offices across the United States
   - Provide On-Scene Commanders with support in terms of radiological monitoring, communications, and information coordination during an emergency
   - Consist of DOE and contracted personnel possessing expertise in health physics, public information, and communications

The FCP TEP is activated when Visionary Solutions, LLC, the truck driver, or the local response organizations contacts the FCP to notify DOE that an incident has occurred. The FCP maintains a 24-hour emergency response telephone number (513-648-4444) through its Communications Center. Communication Center personnel are trained in the

communication and notification procedures in the unlikely event of a transportation incident. In addition, all drivers are provided with a 24-hour toll-free contact number (513-738-2073) to provide responders on-scene with comprehensive emergency response and incident mitigation information regarding the material in the shipment.

The FCP Communications Center provides communication capability for the FCP, monitors conditions, and makes notifications as required. The FCP Communication Center establishes and maintains direct communication with the On-Scene Commander and the FCP Assistant Emergency Duty Officer (AEDO) until the Emergency Operations Center (EOC) is activated.

The FCP EOC is activated at the direction of the AEDO or Emergency Duty Officer (EDO) for events categorized at the emergency level, including transportation events and for non-emergency events at the discretion of the EDO. The EOC officially becomes operational when the Emergency Director or Deputy Emergency Director arrives at the EOC, determines that sufficient personnel are available to manage the response, and declares the EOC operational. The combined efforts of EOC staff members provide support, guidance, and direction to the On-Scene Commander in the field. The EOC staff assumes responsibilities such as making protective action recommendations, providing notifications, and obtaining necessary resources, as required by the specific circumstances of the event.

Motor carriers maintain Emergency Response Plans (ERP), which outline the procedures the carrier's employees must take in the event of an incident. The plan includes notification responsibilities, emergency response procedures for personnel on the scene, environmental considerations, and additional precautions to take in the event of an incident. DOE, as the shipper, will be notified by Visionary Solutions, LLC within 1 hour should an incident occur. Both Visionary Solutions, LLC, and DOE will initiate emergency procedures upon notification.

In addition, all DOT required emergency response information will be contained in the shipping papers and readily available for all law enforcement and emergency response personnel. These are located in a pocket located on the driver's door or within arm's length of the driver.

7.0 OFFSITE STORAGE / DISPOSAL

7.1 TEMPORARY OFFSITE STORAGE OF SILOS 1 AND 2 MATERIALS

7.1.1 Regulatory Information

WCS has an approved Radioactive Materials Possession License (License Number 04971) issued by the TDSHS, authorizing WCS to possess radioactive material for storage and/or treatment. On February 23, 2005, an amendment to this license, specifically addressing temporary storage of the Silos 1 and 2 11e.(2) material in accordance with the limitations of the OU4 ESD, was approved by the DSHS.

7.1.2 WCS Waste Acceptance

Upon arrival at WCS, each container will be surveyed for radioactivity and inspected for proper labeling/markings and container integrity. After being surveyed and inspected, each container will be bar coded with a unique WCS ID# that will be used to track all container movements at WCS. Wireless bar code readers will be used to update WCS's waste management and tracking database. WCS data entry personnel will enter receipt dates, manifest numbers, FCP inventory numbers, radionuclide data, and gross weights for each container into the database.

In order to minimize handling of each container, trucks will be unloaded in the licensed waste storage area via a crane equipped with the specialized grapple device. Trucks will then be surveyed and released for return to the FCP.

7.1.3 Temporary Storage at WCS

The Silos 1 and 2 containers will be stored on an asphalt pad that has been sealed with an impervious coating and equipped with engineered Stormwater run-off and drainage control features. Throughout the storage period, the containers will be inspected by trained WCS personnel on a monthly basis for evidence of tampering, leakage and container deterioration.

7.2 FINAL DISPOSAL

As required by the OU4 ESD, and by WCS's Radioactive Materials License, no more than two years from the date storage of Silos 1 and 2 material at WCS is initiated, the material will be either 1) permanently disposed at WCS facility in accordance with the OU4 remedy, an approved 11e.(2) disposal license, and all other applicable regulatory requirements, or 2) transported to a government-owned facility and/or a PCDF for permanent disposal. The details concerning permanent disposal at WCS or another government owned or commercial facility, including any subsequent transportation, will be

documented and submitted for review and approval in a Transportation and Disposal Plan revision no later than 18 months from the initiation of temporary storage at WCS.

8.0 FCP HEALTH AND SAFETY REQUIREMENTS

8.1 NUCLEAR AND SYSTEMS SAFETY

The FCP Nuclear and System Safety Program is identified in RM-2116, System Safety Requirements and is implemented by Fluor Fernald through site procedures. Safety analyses are performed to help ensure the health and safety of the public, the workers, and the environment. A Nuclear Health and Safety Plan (NHASP) for operation of the Silos 1 and 2 Project has been prepared and approved by DOE.

The Silos Project safety analysis documentation addresses staging of material and motor vehicle shipping activities. All shipments and containers (including Silos 1 and 2 shipping containers) will comply with DOT regulations, which will help to ensure the health and safety of the public, the workers, and the environment.

8.2 OCCUPATIONAL SAFETY AND HEALTH

The FCP Occupational Safety and Health Program requirements are defined in the RM-0021, Safety Performance Requirements (SPR) Manual. The SPRs apply to activities at the FCP. SPRs identify requirements established by federal, state, and local regulations, in addition to requirements from DOE Orders and Best Management Practices established by Fluor Fernald through experience, lessons learned, and employee input. SPRs identify safety and health standards for assessing and planning work at the FCP. Silos 1 and 2 material shipments will be performed in accordance with existing shipping procedures, which incorporate the required SPRs.

8.3 RADIOLOGICAL PROTECTION

Equipment and material, including containers of Silos 1 and 2 materials, will be released from the Silos 1 and 2 facility when the exterior of the item meets DOT surface contamination limits. Therefore, it is planned that shipment-preparation activities will take place in a Controlled Area. FCP Radiological Control Technicians (RCTs) will conduct routine radiological surveys to ensure contamination levels are maintained below Contamination Area limits. FCP Radiological Control will survey the exterior of each container for compliance with DOT regulations and Fluor Fernald Radiological Protection Program (RPP) requirements. Exterior non-fixed contamination levels will be determined per 49 CFR 173.443, Contamination Control for shipments and 10 CFR 835, Occupational Radiation Protection for staging. Once the containers have been surveyed and are ready for release, they will be loaded onto flatbed trailers. After the trailers have been surveyed and released, they will be transported to the TSA or other on-site staging location.

If the equipment or material in the Controlled Area exceeds Contamination Area levels, a Contamination Area will be established and a new Radiation Work Permit (RWP) will be issued. The RWP will define the level of anti-contamination clothing and RCT coverage required. If decontamination is feasible, decontaminating the work surface to a level below Contamination Area limits will eliminate the need for routine wearing of anti-contamination clothing and reduce the RCT coverage requirements. If/when Contamination Areas are established, whole body monitoring will be required for exiting the area. Immediately following the completion of work, the area will be decontaminated, as necessary, and surveyed for the purpose of down-posting.

Detailed project-specific radiological control requirements are developed and incorporated into procedures and work permits.

Only necessary personnel with the appropriate training will be given access to the radiologically controlled areas. The crew will ingress/egress through a radiological control point(s) and will be subject to personal contamination monitoring upon exit. Incidents of personal contamination will be addressed per existing, approved site procedures.

In addition to the FCP radiation protection program, transportation contractors will be required to implement a personnel radiation protection program in accordance with 10CFR 20 to ensure that no driver exceeds the 5000mrem (5rem) annual dose limit.

8.4 SECURITY

Areas where Silos 1 and 2 materials will be loaded and staged pending the completion of shipment will be provided with the appropriate levels of security and lighting. FCP Security monitors site access by using stationary posts and conducting walking, driving, and perimeter patrols on a 24-hour basis.

9.0 REFERENCES

Code of Federal Regulations, 10 CFR 835,"Occupational Radiation Protection"

Code of Federal Regulations, 10 CFR Chapter 1,"Nuclear Regulatory Commission"

Code of Federal Regulations, 40 CFR 261.4, "Identification and Listing of Hazardous Waste, Exclusions"

Code of Federal Regulations, 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"

Code of Federal Regulations, 41 CFR 101-40, "Transportation and Traffic Management"

Code of Federal Regulations, 49 CFR 171-180, "Hazardous Materials Regulations"

Code of Federal Regulations, 49 CFR 107, "Hazardous Materials Program Procedures"

Code of Federal Regulations, 49 CFR 350-399, "Federal Motor Carrier Safety Administration"

Fernald Environmental Management Project, 1994, "Remedial Investigation Report, Operable Unit 4," OU4RI-6-Final, November, 1994

Fluor Fernald, 2000, "Record of Decision Amendment for Operable Unit 4 Silos 1 and 2 Remedial Action," 40700-RP-0008, July 13, 2000.

Fluor Fernald, 2001, "FCP Emergency Plan," PL-3020, Revision 6, October 2001

Fluor Fernald, 2001, "FCP Spill Prevention Control and Countermeasure Plan," PL-2194, Revision 5, November 2001

Fluor Fernald, 2001, "FCP Transportation Emergency Plan," PL-3043, Revision 4, September 2001

Fluor Fernald, 2002, "Radiological Control Requirements Manual," RM-0020, Revision 15, March 2002

Fluor Fernald, 2001, "System Safety Requirements," RM-2116, Revision 7, April 2001

Fluor Fernald, 2002, "Safety Performance Requirements," RM-0021, Revision 35, February 2002

Fluor Fernald, 2002, "Silos Area Emergency Procedure," EM-0030, Revision 6, October 17, 2002

Fluor Fernald, 2002, "Fluor Fernald Waste Certification Program Plan, Revision 7, December 2002.

Fluor Fernald, 2003, "Silos 1 and 2 Remediation Facility Remedial Design Package," 40750-RP-0028, Rev. 0, April 2003.

Fluor Fernald, 2003, "Final Record of Decision Amendment for Operable Unit 4, Silos 1 and 2 Remedial Action, (40430-RP-0026, Rev. 0), August 2003.

Fluor Fernald, 2003, "Final Explanation of Significant Differences for Operable Unit 4 Silos 1 and 2 Remedial Action," 40750-RP-0038, November 24, 2003.

Fluor Fernald, 2003, "Silos 1 and 2 Project Remedial Design/Remedial Action Package," (40430-RDP-0001), Rev. 2., December 2003.

Fluor Fernald, 2004, "Silos 1 and 2 Retrieval and Disposition Nuclear Health and Safety Plan," Revision 0, February 9, 2004

Fluor Fernald, 2005, "Final Explanation of Significant Differences for Operable Unit 4 Remedial Actions," 40000-RP-0037, January 2005

U.S. Department of Energy, 1984, "Radioactive Waste Management," DOE-435.1

U.S. Department of Energy, 1992, "Hazard Categorization and Accident Analysis Techniques For Compliance With DOE Order 5480.23, Nuclear Safety Analysis Reports," DOE-STD-1027-92, December 1992

U.S. Department of Energy, "Departmental Materials Transportation and Packaging Management," DOE-460.2-1, September 2002

U.S. Department of Energy, "Packaging and Transportation Safety," DOE Order 460.1B, April 2003

U.S. Department of Energy, "Comprehensive Emergency Management System," DOE-151.1B, October 2003

U.S. Department of Energy, , "Radioactive Waste Management," DOE-435.1, August 2001

U.S. Department of Energy, 2003, "Safety Basis Requirements," 10 CFR 830, Subpart B, January 2003

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APPENDIX A
SILOS 1& 2 MATERIAL LSA DETERMINATION (HM-230, EFF. OCTOBER 1, 2004)

APPENDIX A
SILOS 1& 2 MATERIAL LSA DETERMINATION (HM-230, EFF. OCTOBER 1, 2004)

DOT regulations, under 49 Code of Federal Regulations (CFR) Part 173.403, categorize low specific activity (LSA) material into three classifications: LSA-I, LSA-II, and LSA-III. To be considered LSA material, the material need only meet criterion under one of the classifications. Evaluation of the radiological content of the Silos 1 and 2 materials indicates these materials meet one criterion for LSA-II material. Specifically, Silos 1 and 2 materials are considered "other material in which the radioactive material is distributed throughout and the estimated average specific activity does not exceed 10-4 A2/g for solids..."

Table A-1 below represents the source term for the Silos 1 and 2 materials, as well as the LSA classification and packaging determinations.

Column 1 identifies each radionuclide present in the Silos 1 and 2 materials.

Columns 2 and 4 identify the activity concentration for each radionuclide in terabecquerels per gram (TBq/g) and becquerels per gram (Bq/g), respectively. Columns 3 and 5 identify the total activity of each radionuclide in terabecquerels (TBq) and becquerels (Bq), respectively. The values in Columns 3 and 5 were arrived at by taking the activity concentration per radionuclide multiplied by the net weight in grams of material.

The radionuclide specific limits shown in Columns 6 and 8 are prescribed by 49 CFR 173.436. 49 CFR 173.436 Footnote (b) specifies the progeny that have been taken into consideration when assigning the activity concentration and consignment limits of the parent. The table provides a list of these parent/progeny relationships included in Silos 1 and 2 materials.

Column 7 contains the result of the unity calculation per nuclide for the activity concentration limit for exempt material (ACEM) and is derived by the following:
Column 4, "Activity Concentration (Bq/g)" divided by Column 6, "ACEM [Activity Concentration Limit for Exempt Material] (Bq/g)"

Column 9 contains the result of the unity calculation per nuclide for the activity limit for exempt consignment (ALEC) and is derived by the following:
Column 5, "Total Activity (Bq)" divided by Column 8, "ALEC [Activity Limit for Exempt Consignment] (Bq)"

If the sum of either column is less than or equal to 1, then the material is not regulated as Class 7 radioactive material. As demonstrated in the table, the sum of each unity calculation individually exceeds 1; therefore, the Silos 1 and 2 material meets the definition of Class 7 radioactive material.

Column 10 identifies the applicable LSA-I limit, which is 30 times the ACEM. Column 11 contains the result of the unity calculation per nuclide for LSA-I and is derived by the following:
Column 4, "Activity Concentration (Bq/g)" divided by Column 10, "LSA-I(1)(iv) 30x Activity Concentration Limit (Bq/g)"

If the sum of Column 11 exceeds 1, then the radioactive material cannot be shipped as LSA-I material. As shown in the table, the LSA-I unity calculation greatly exceeds 1; therefore, it does not meet the definition of LSA-I.

Column 14 identifies the A2 values prescribed by 49 CFR 173.435. 49 CFR 173.435, Footnote (a), indicates that certain A2 values already include the contributions from daughter nuclides with half-lives less than 10 days and considered to be in secular equilibrium with their parent nuclide. The table provides a list of these parent/daughter relationships included in Silos 1 and 2 materials.

The definition of LSA-II solid material found at 173.403 *LSA material* requires that the activity is distributed throughout and the average specific activity of the material is less than 10^{-4} A_2/g. This limit is identified in Column 12. Column 13 contains the result of the unity calculation per nuclide for LSA-II and is derived by the following:
Column 2, "Activity Concentration (TBq/g)" divided by Column 12, "LSA-II (2)(ii) Limits 10^{-4} A2/g"

If the sum of Column13 exceeds 1, then the radioactive material cannot be shipped as LSA-II material. As shown in the table, the sum of the LSA-II unity calculation does not exceed 1; therefore, it can be classified and shipped as LSA-II material. At this point, it has been determined the Silos 1 and 2 material meets the DOT definitions of radioactive and LSA-II material.

Column 15 contains the result of the A2 unity calculation per nuclide and is derived by the following:
Column 3, "Total Activity (TBq)" divided by Column 14, "A2 Limits (TBq)"

If the sum of Column 15 exceeds 1, thereby exceeding an A2 quantity, the material cannot be shipped in an excepted package as permitted by 173.427(b)(4). As shown in the table, the sum of the A2 unity exceeds 1; therefore, the Silos 1 and 2 material must and will be packaged in a Type IP-2 packaging, subject to the limitations of Table 6, as required by 49 CFR 173.427 (b)(1). Per Table 5, the activity limit for the conveyance is unlimited for LSA-II Non-combustible Solids.

TABLE A-1

Project: Silos 1 & 2 Transportation & Disposal Plan - Appendix A
Container: Non-Bulk IP-2
Weight/Unit: 19000 Lbs.
Net Weight: 19000.0 Lbs. **Net Wt (Gms):** 8,618,210.0

					49 CFR 173.436 [HM-230]				49 CFR 173.403 [HM-230]				49 CFR 173.435 [HM-230]	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Radionuclide	Activity Concentration (TBq/g)	Total Activity (TBq)	Activity Concentration (Bq/g)	Total Activity (Bq)	ACEM [Activity Concentration Limit for Exempt Material] (Bq/g)	ACEM Unity	ALEC [Activity Limit for Exempt Consignment] (Bq)	ALEC Unity	LSA-I (1)(iv) 30X Activity Concentration Limit (Bq/g)	LSA-I Unity	LSA-II (2)(ii) Limits 10^{-4} A2/g	LSA-II Unity	A2 Limits (TBq)	A2 Unity
Ac-227	5.809E-11	5.006E-04	5.809E+01	5.006E+08	1.000E-01	5.809E+02	1.000E+03	5.006E+05	3.000E+00	1.936E+01	9.000E-09	8.454E-03	9.000E-05	5.563E+00
Ac-228	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Bi-210	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Bi-211	5.809E-11	5.006E-04	5.809E+01	5.006E+08	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Bi-212	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Bi-214	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Fr-223	8.029E-13	6.920E-06	8.029E-01	6.920E+08	1.000E+01	8.029E-02	1.000E+04	6.920E+02	3.000E+02	2.676E-03	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Pa-231	5.809E-11	5.006E-04	5.809E+01	5.006E+08	1.000E+00	5.809E+01	1.000E+03	5.006E+05	3.000E+01	1.936E+00	4.000E-08	1.452E-03	4.000E-04	1.252E+00
Pa-234m	3.156E-12	2.720E-05	3.156E+00	2.720E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Pb-210	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Pb-211	5.809E-11	5.006E-04	5.809E+01	5.006E+08	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	5.000E-06	6.268E-04	5.000E-02	5.402E-01
Pb-212	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Pb-214	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-210	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-211	1.587E-13	1.368E-06	1.587E-01	1.368E+06	1.000E-01	1.587E+00	1.000E+03	1.368E+03	3.000E+00	5.291E-02	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-212	3.034E-12	2.615E-05	3.034E+00	2.615E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-214	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-215	5.809E-11	5.006E-04	5.809E+01	5.006E+08	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-216	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Po-218	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Ra-223	5.809E-11	5.006E-04	5.809E+01	5.006E+08	1.000E+02	5.809E-01	1.000E+05	5.006E+03	3.000E+03	1.936E-02	7.000E-07	8.299E-05	7.000E-03	7.152E-02
Ra-224	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Ra-226	3.134E-09	2.701E-02	3.134E+03	2.701E+10	1.000E+01	3.134E+02	1.000E+04	2.701E+06	3.000E+02	1.045E+01	3.000E-07	1.045E-02	3.000E-03	9.003E+00
Ra-228	4.736E-12	4.082E-05	4.736E+00	4.082E+07	1.000E+01	4.736E-01	1.000E+05	4.082E+02	3.000E+02	1.579E-02	2.000E-08	2.368E-06	2.000E-02	2.041E-03
Rn-219	5.809E-11	5.006E-04	5.809E+01	5.006E+08	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Rn-220	4.736E-12	4.082E-05	4.736E+00	4.082E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Rn-222	3.134E-09	2.701E-02	3.134E+03	2.701E+10	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Th-227	5.809E-11	5.006E-04	5.809E+01	5.006E+08	1.000E+01	5.809E+00	1.000E+04	5.006E+04	3.000E+02	1.936E-01	5.000E-07	1.162E-04	5.000E-03	1.001E-01
Th-228	4.736E-12	4.082E-05	4.736E+00	4.082E+07	1.000E+00	4.736E+00	1.000E+04	4.082E+03	3.000E+01	1.579E-01	1.000E-07	4.736E-05	1.000E-03	4.082E-02
Th-230	4.662E-10	4.018E-03	4.662E+02	4.018E+09	1.000E+00	4.662E+02	1.000E+04	4.018E+05	3.000E+01	1.554E+01	1.000E-07	4.662E-03	1.000E-03	4.018E+00
Th-231	1.443E-13	1.244E-06	1.443E-01	1.244E+06	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Th-232	4.736E-12	4.082E-05	4.736E+00	4.082E+07	1.000E+01	4.736E-01	1.000E+04	4.082E+03	3.000E+02	1.579E-02	Unlimited	0.000E+00	Unlimited	0.000E+00
Th-234	3.156E-12	2.720E-05	3.156E+00	2.720E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	3.000E-05	1.052E-07	3.000E-01	9.007E-05
Tl-207	5.809E-11	5.006E-04	5.809E+01	5.006E+08	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
Tl-208	1.706E-12	1.470E-05	1.706E+00	1.470E+07	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(b) - Progeny	0.000E+00	(a) - Daughter	0.000E+00	(a) - Daughter	0.000E+00
U-234	3.156E-12	2.720E-05	3.156E+00	2.720E+07	1.000E+01	3.156E-01	1.000E+05	2.720E+02	3.000E+02	1.052E-02	6.000E-07	5.260E-06	6.000E-03	4.533E-03
U-235	1.443E-13	1.244E-06	1.443E-01	1.244E+06	1.000E+01	1.443E-02	1.000E+04	1.244E+02	3.000E+02	4.810E-04	Unlimited	0.000E+00	Unlimited	0.000E+00
U-238	3.156E-12	2.720E-05	3.156E+00	2.720E+07	1.000E+01	3.156E-01	1.000E+04	2.720E+03	3.000E+02	1.052E-02	Unlimited	0.000E+00	Unlimited	0.000E+00
TOTALS						1.433E+03		4.173E+06		4.777E+01		2.548E-02		2.194E+01
RESULTS					RADIOACTIVE ? (T/F): TRUE				Not LSA-I		LSA-II		>A2	

173.436, Footnote (b) - Parent nuclides and their progeny included in secular equilibrium are listed in the following:

Parent	Progeny
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Tl-207
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Pb-210, Bi-210, Po-210
Ra-228	Ac-228
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
U-235	Th-231
U238	Th-234, Pa-234m

173.435, Footnote (a) - A_2 values include contributions from daughter nuclides with half-lives less than 10 days.:

Parent	Daughter
Ac-227	Fr-223
Ra-223	Rn-219, Po-215, Pb-211, Bi-211, Po-211, Tl-207
Ra-226	Rn-222, Po-218, Pb-214, Bi-214, Po-214, Bi-210
Ra-228	Ac-228
Th-228	Ra-224, Rn-220, Po-216, Pb-212, Bi-212, Tl-208, Po-212
Th-234	Pa-234m
U-235	Th-231